Don't Ignore the Fundamentals of Mapping using DRONES

Mike Tully

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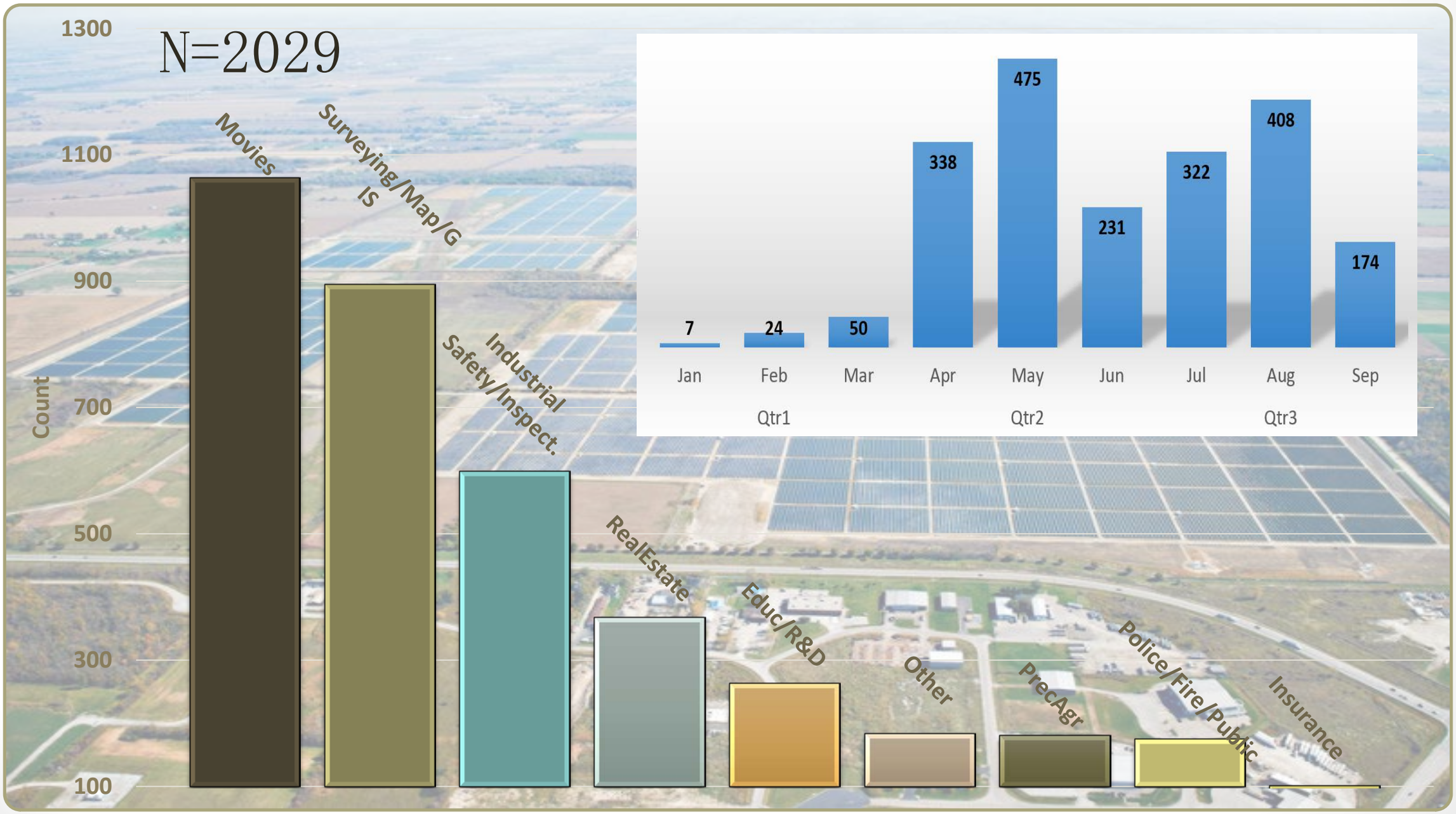
Aerial Services, Inc.

@tullymike

tullymike

Exemptions to Date

(YTD to 14 Sep)



"The actors in this video are highly trained professional drone operators."

Wind

Wind causes blur, instability, holes in coverage
15-20 mph is a lot

Credit: Adrian Sommeling Photography

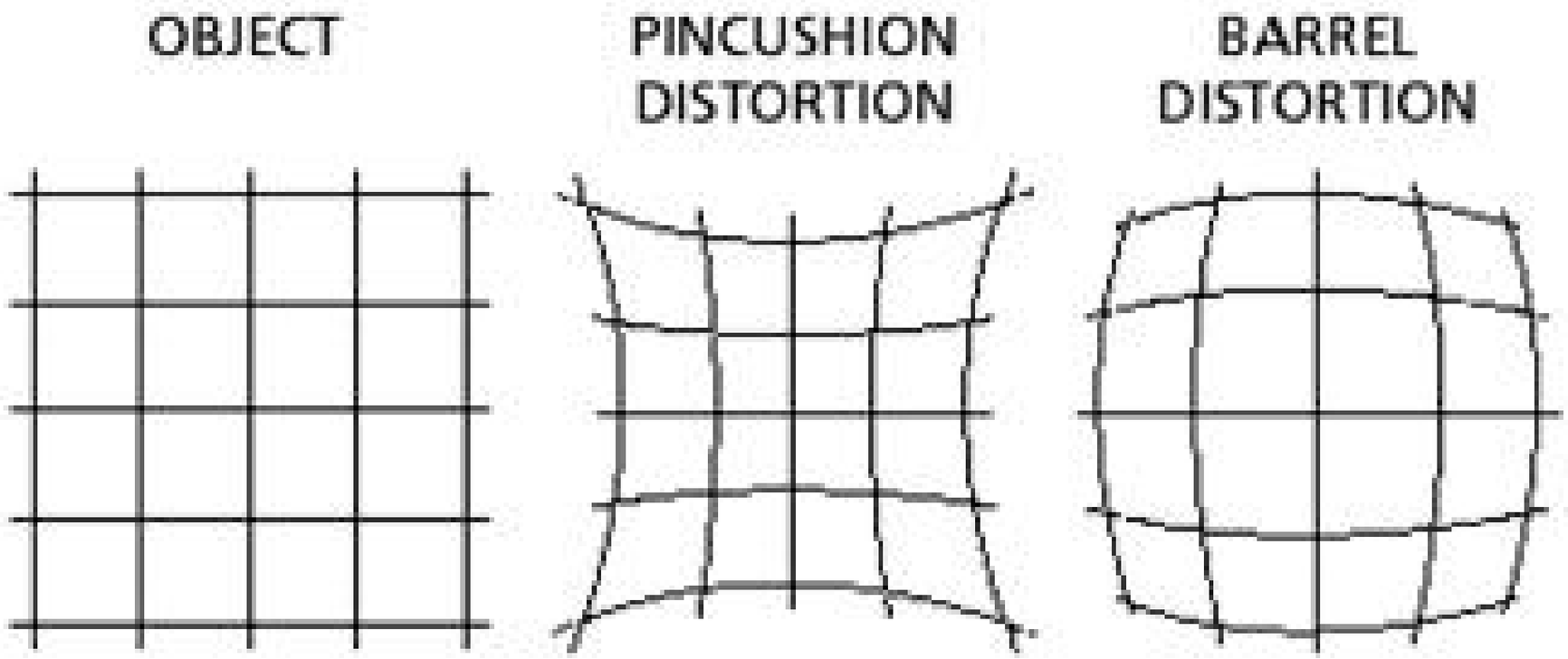
Pitch & Roll Stabilit

How stable in flight is the camera?

Is a stabilized mount needed?

2-axis or 3-axis?

Metric Camera



Stable Characteristics
Repeatable
Lens Distortion modelled away

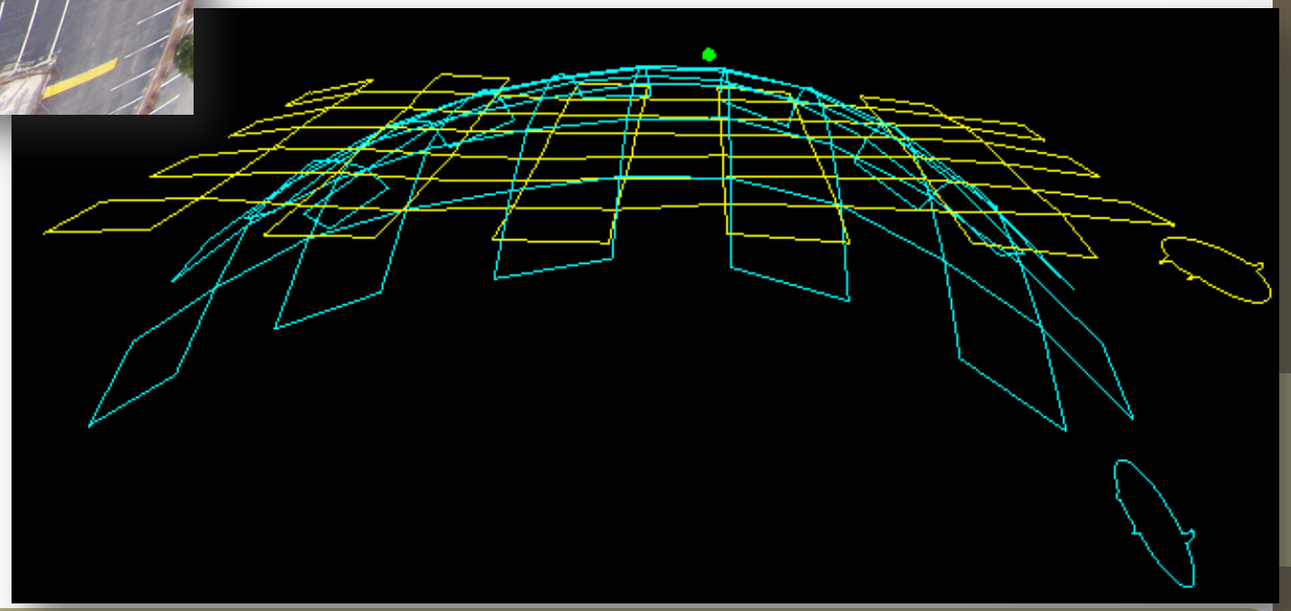
Metric Camera

Lens Distortion = ERROR!

XY

and in

Z



M. Kitaif, Cardinal Systems

Metric Camera

Go Pro
Camera

Prelim. Results: Meets USGS Level 2 Accuracy Standards

Compliments: G. Wehrli,
B. Crawbuck, M. Kitaif, Cardinal Systems

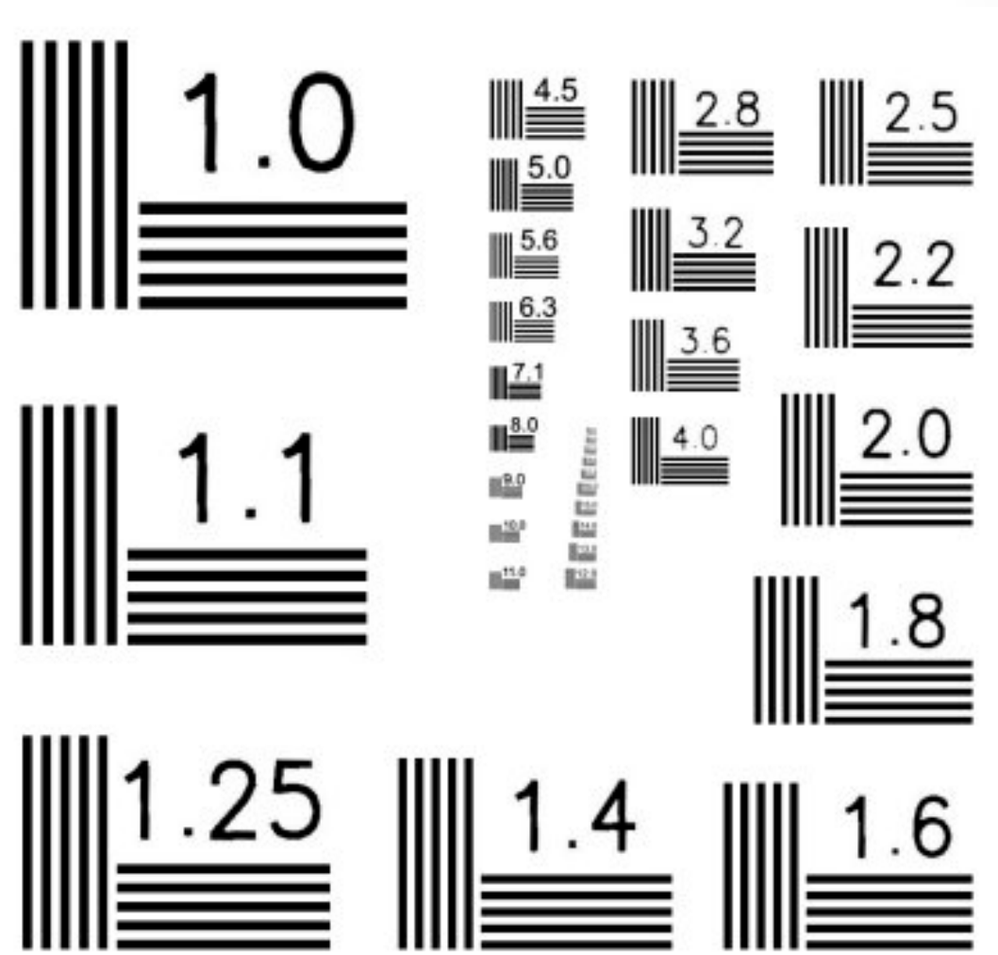
Aerial Services, Inc.

Dynamic Range

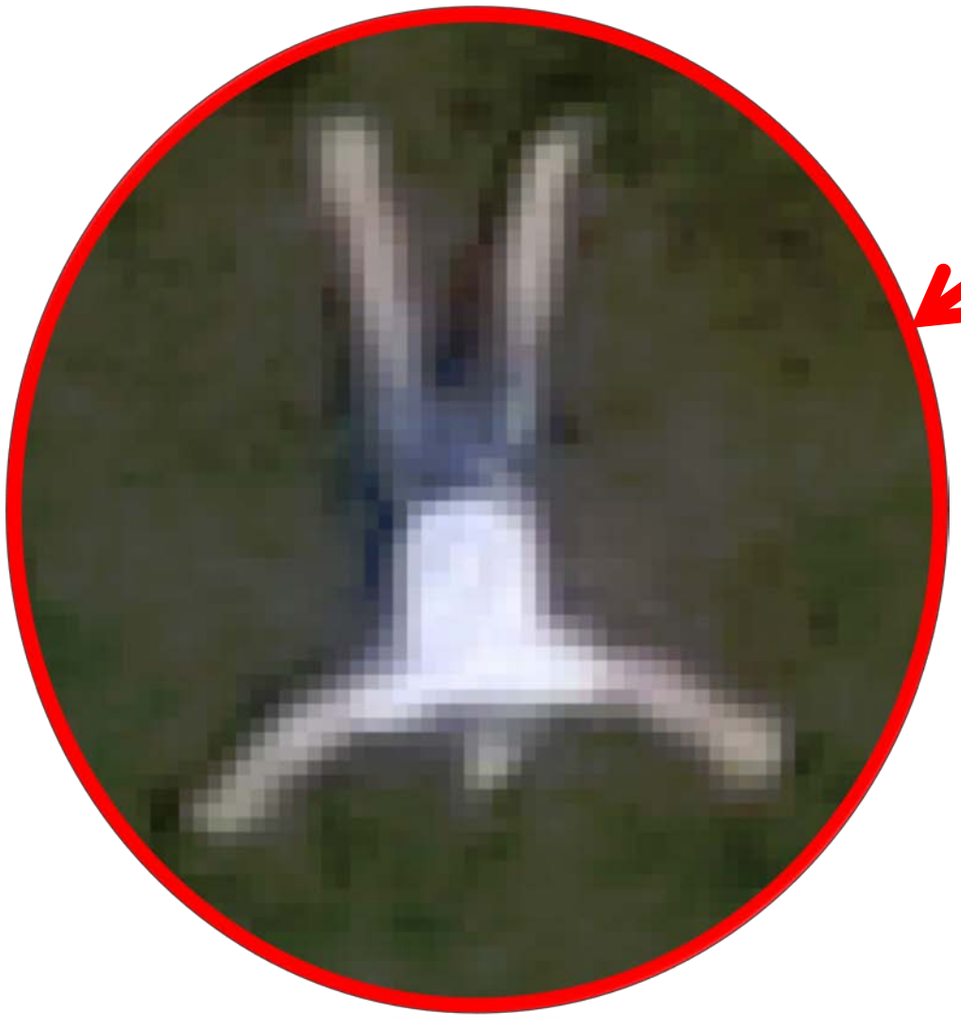
A measure of the camera's sensitivity to light
(Higher is better)

Not ONLY effected by exposure settings!

Resolving Power

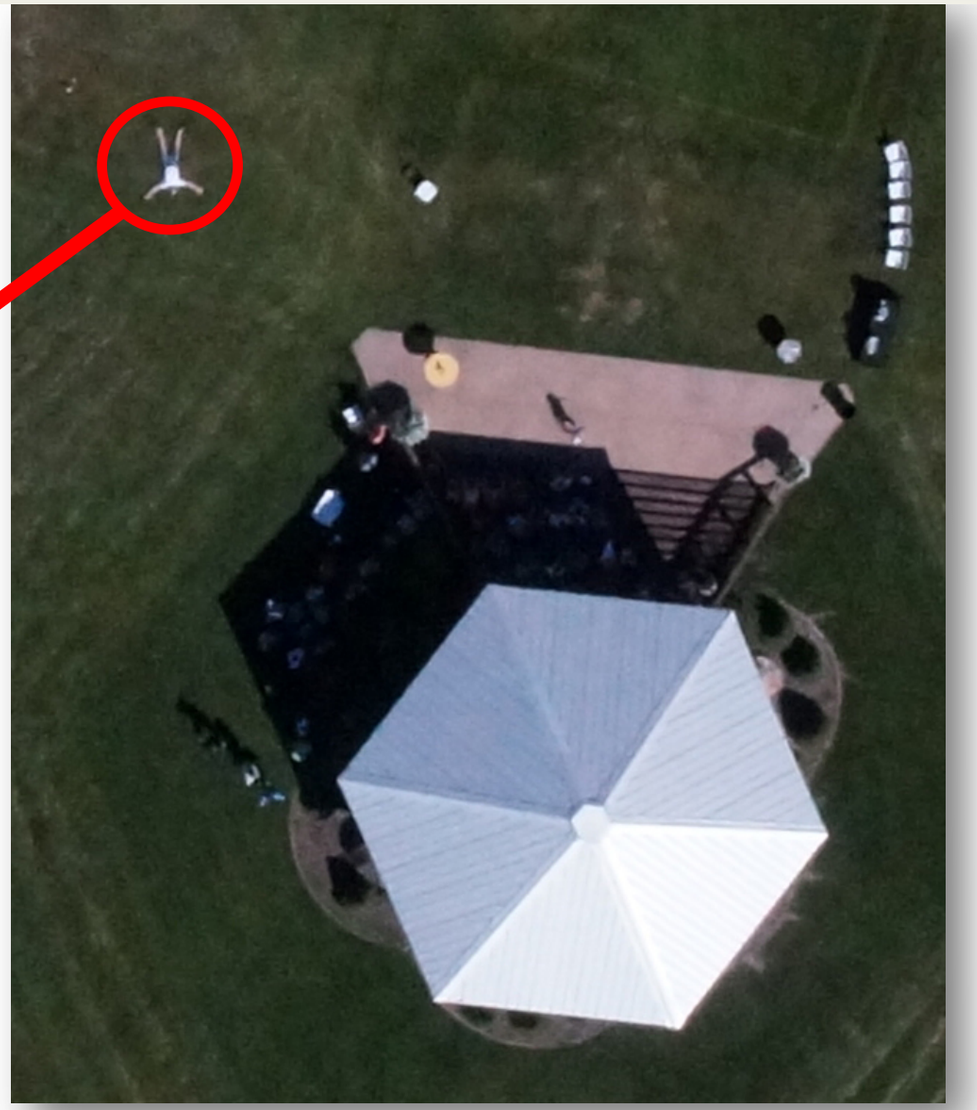


Resolving Power



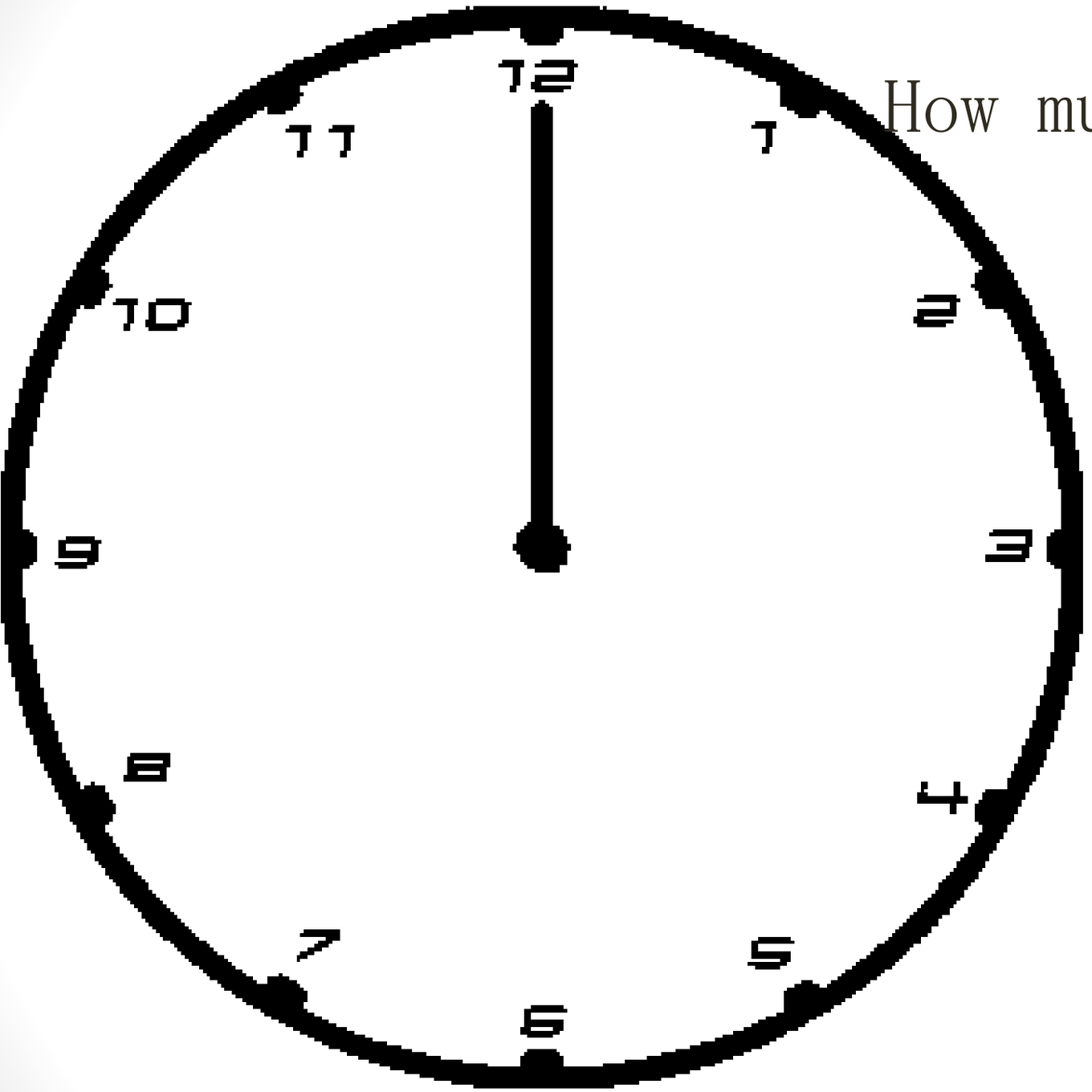
High Resolution (GSD)

Low Resolving Power



Trimble UX5
400′ AGL

Time & Space



How much area can I cover?

How long will it take?

Contingencies?

Acquisition by Drone: Half Day

Chicago Ohare Airport

400’ AGL: 1 sq mi

On good day!

6″ GSD: 250 sq mi

Training

Are pilots and observers trained?
Drones, spares, computers, batteries, cables?
Weather?

Power

100 acres per battery

30 minutes tops; less on windy day

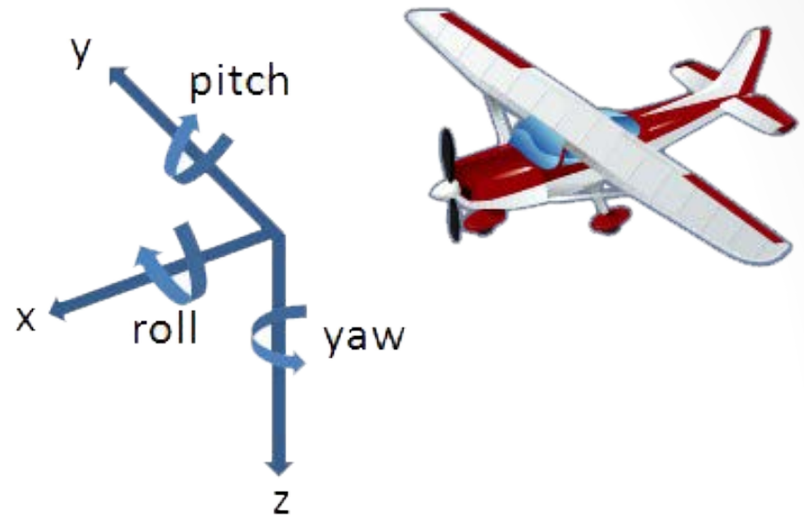
Recharging in field is slow
Bring 3-4 fully charged to field

Do you need a gas engine drone?

Ground Control

- How is the data validated?
- Are points needed?
- How many points?
- Point locations?
- Why does it matter?
- What's the intended use?

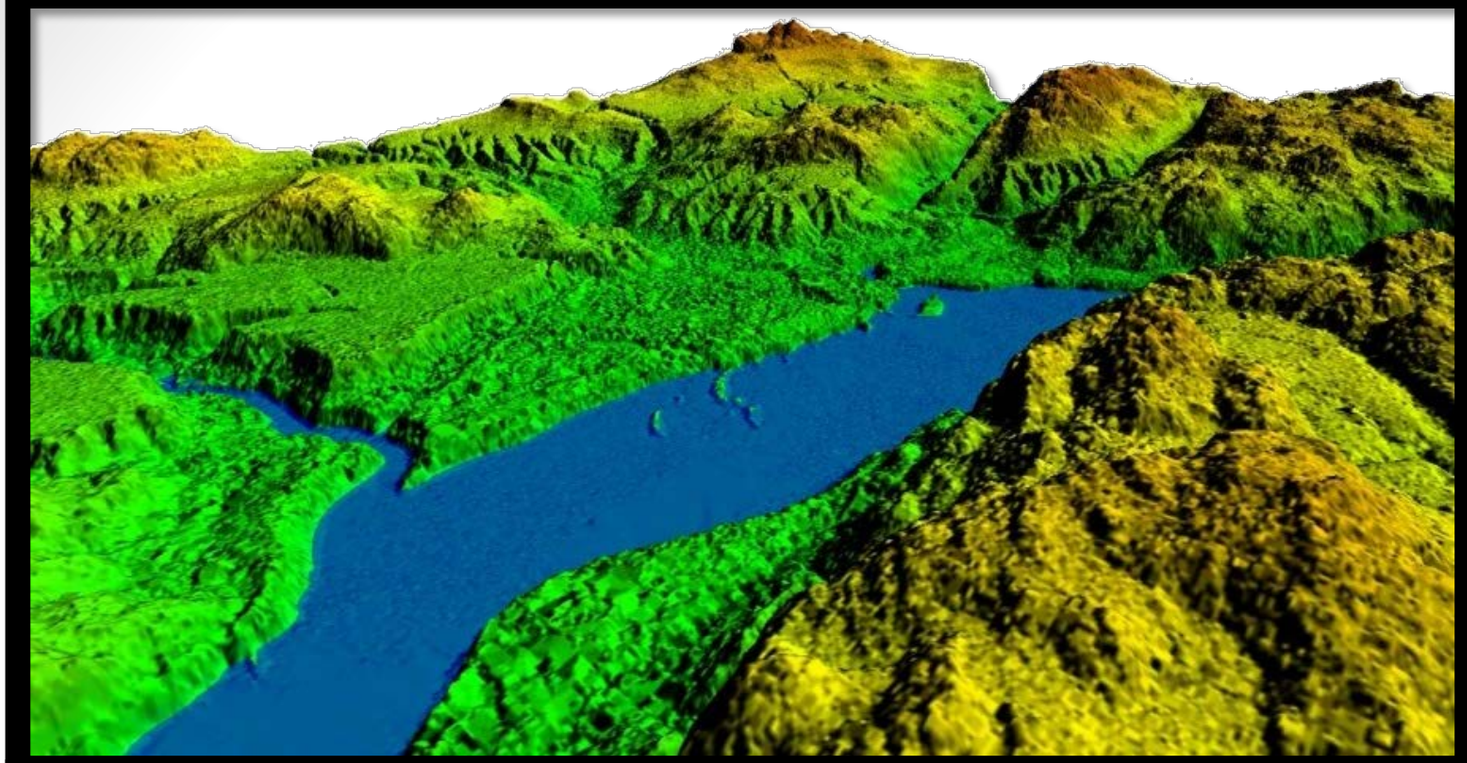
Acquisition

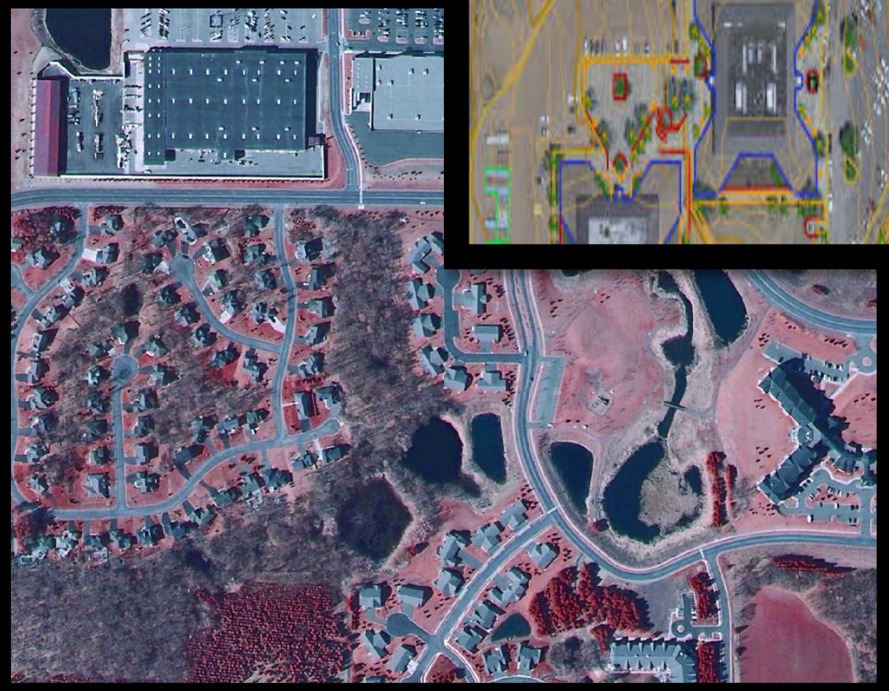


- **Integrated GPS & IMU**:
  - One or both or neither?
  - GPS: position
  - IMU: orientation
- **Swath Width**: How much ground does one frame cover from altitude?
- **SideLap, EndLap**: How much overlap between frames? Stereo (3D) needed?
- **Image Bands**:
  - Color, InfraRed, RedEdge?
  - 1-band, 3-band, or 4-band?

LiDAR

- Do you need it?
- Some sensors available now
- Flash LiDAR is coming





OUTPUTS

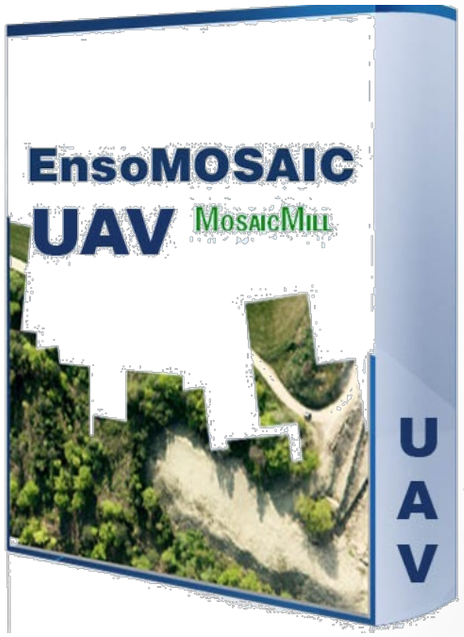
Point Clouds (DEM)

- Semi-Global Matching
- Digital Surface Models
- Digital Terrain Models, breaklines

GeoCue

LP360 GeoCue Group

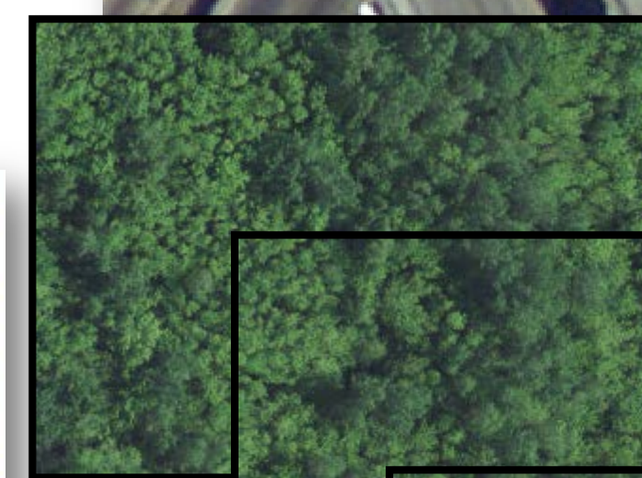
Pix4D



simactive

Orthophotography

- AeroTriangulation
- Mosaic
- Seam Editing
- Color Balance
- Distributed Processing



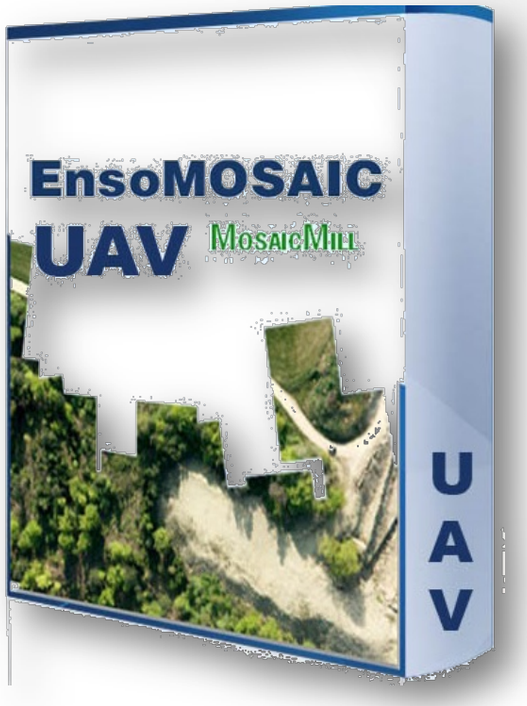
Orthophotography

- Trade-offs of Speed and accuracy
- Important Software Attributes
  - Self-calibration
  - QA/QC Reporting
  - Can Error Weighting be Used?

Ortho Software

ArcGIS ESRI

AERO GIS BY GISCAT



GeoCue LP360 GeoCue Group

OrthoVista

simactive

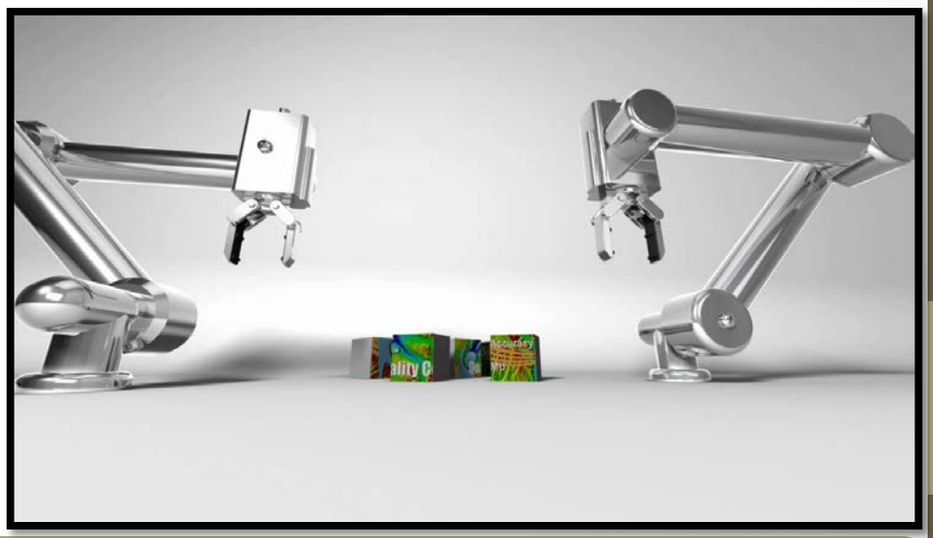
Pix4D

PhotoScan
3D Modeling and Mapping
Agisoft

QUALITY CONTROL & ACCURACY

Quality Control & Accurac

- Was GPS and IMU acquired?
- Ground control are essential to validate positional accuracy
- What's the "Intended Use" of the data?
- Best small Drone accuracy today: 10 cm
- Accuracy testing needed?
- Which Positional Accuracy Standards met?



ASPRS Positional Accuracy Standards

(NOVEMBER, 2014)

Orthophotography		
Horizontal Accuracy Class	**Horizontal Accuracy (RMSE xy)**	**OrthoMosaic Seamline Mismatch**
I	Pixel size x 1.0	Pixel Size x 2.0
II	Pixel size x 2.0	Pixel Size x 4.0
III	Pixel size x 3.0	Pixel Size x 6.0

There are additional, tighter standards for planimetric mapping AND elevations (DEMs).

ASPRS Positional Accuracy Standards

(NOVEMBER, 2014)

Orthophotography		
GSD (cm)	**RMSE xy (pixels)**	**Recommended use**
5.0	≤ 1 pixel (5 cm)	*Highest accuracy*
5.0	2 pixels (10 cm)	*Standard mapping*
5.0	≥ 3 pixels (15 cm)	*Visualization, GIS*

There are additional, tighter standards for planimetric mapping AND elevations (DEMs).

Summary

- Drones are great, new tools
  - Disruptive & amazingly capable
  - Easy to fly. Hard to “use”.
- Understand the tool
- Understand the “Intended Use”
- This will drive needs for “accuracy”.

Thank You!

Mike Tully, President & CEO
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